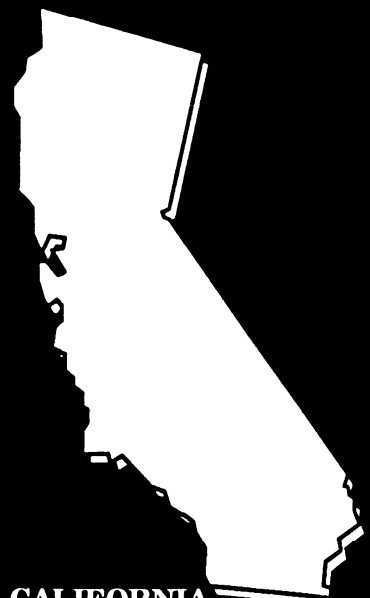


A STUDY OF CHEMICAL CONTAMINATION OF MARINE FISH FROM SOUTHERN CALIFORNIA

SUMMARY

II. COMPREHENSIVE STUDY

September 1991



**CALIFORNIA
ENVIRONMENTAL
PROTECTION AGENCY**

OEHHA
**OFFICE OF ENVIRONMENTAL
HEALTH HAZARD ASSESSMENT**

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EXECUTIVE SUMMARY

During the 1960s and 1970s, the discharge of industrial chemicals from the manufacturing of pesticides and other products contaminated ocean sediments along the coast of southern California. These contaminants were carried into the ocean from sewage and refinery discharges, storm drains and river drainage, waste dumping from barges, and other unidentified sources. Several million pounds of DDT alone were estimated to have been deposited on the Palos Verdes Shelf from sewage outfalls. The stable nature of chemicals such as DDT and polychlorinated biphenyls (PCBs) in the environment and their cancer causing potential have led to concerns about the health effects of consuming fish caught off this coastal area by sports anglers.

This report describes the results of a comprehensive study and health evaluation (risk assessment) of chemical contaminants in sports fish species in southern California. The study was conducted by the Office of Environmental Health Hazard Assessment (OEHHHA) and its precursor organization in the California Department of Health Services (DHS), in cooperation with the California Department of Fish and Game, as required by Section 23 of Chapters 1,440 of the Statutes of 1985.

The purpose of the study was to collect a large number of fish species from representative locations in southern California, determine the concentrations of selected chemical contaminants in edible tissues, and evaluate the health significance of these levels so that specific guidelines for safe consumption of fish taken from this area could be developed.

Fish were collected from 24 sites in southern California, which represent areas fished by pier, private boat, and party boat anglers. A total of 15 different species of fish were sampled in the study, but not all 15 species were sampled at any one site. At each site five to ten different species of fish were sampled.

Generally, 20 fish of a single species were collected from each site. In addition, limited analyses of contaminant concentrations and fish size were conducted at seven sites (rockfishes and surfperches), and the effect of seasonal changes on contaminant concentrations was examined for white croaker at Cabrillo Pier. In total, nearly 4,000 fish were sampled in the study, and approximately 1,000 chemical analyses were performed on composite samples from the fish.

Selection of Contaminants, Species, and Sites

DHS began by conducting a pilot study to identify the chemical contaminants of concern for analysis in the comprehensive study. These chemicals are those which on the basis of their concentration in the fish tissues and their toxicity or cancer-causing properties showed the ability to contribute to potential health risks and required further study. This procedure for identifying chemicals for inclusion in the comprehensive study was needed because of the high cost of laboratory analyses and to determine where specialized analytical methods would be needed. Of more than 100 chemicals analyzed for in the pilot study, PCBs and DDT were found to have a potential health risk. While some other toxic compounds were detected, their concentrations were not found to be sufficiently high to cause a health concern. PCBs and DDTs were therefore chosen for analysis in the comprehensive study. Both are carcinogenic in laboratory animals and suspected of causing cancer in humans.

Several other contaminants were also examined in the comprehensive study: chlordane, mercury, and tributyltin. Chlordane is another carcinogenic pesticide (like DDT) with wide domestic use and potential for contamination. Organic mercury is an organic metal which can cause nervous system damage, especially to the fetus. There were concerns that it might concentrate in higher trophic level fish species, that is, in fish higher up the food web. Tributyltin is mainly toxic to the immune system. It was included because

it is the active ingredient of some anti-fouling paints applied to boat bottoms, and there was concern about its concentration in fish from marinas or other protected areas that get little flushing action. Tributyltin-containing paints were introduced relatively recently but were banned two years ago because of potential damage to shellfish.

Fish species were selected for sampling in the study based on several factors, the most important of which was the frequency of catch. Fish species sampled in the study were sculpin (*Scorpaena guttata*), rockfish species (*Scorpaenidae*), barred sand bass (*Paralabrax nebulifer*), kelp bass (*Paralabrax clathratus*), pacific bonito (*Sarda chiliensis*), pacific mackerel (*Scomber japonicus*), California halibut (*Paralichthys californicus*), pacific sand dab (*Citharichthys sordidus*), corbina (*Menticirrhus undulatus*), white croaker (*Genyonemus lineatus*), queenfish (*Seriphus politus*), surfperch species (*Embiotocidae*), California barracuda (*Sphyræna argentea*), opaleye (*Girella nigricans*), halfmoon (*Medialuna californiensis*), and black croaker (*Chielotrema saturnum*).

Sampling sites were chosen after consultation with experts from DFG, EPA, consultants, and DHS. All collecting sites were frequently fished and were selected to represent the three types of fishing activities: pier, private, and party boat fishing.

Party and private boat sites sampled in the study were near Point Dume, Malibu, Marina del Rey, Short Bank, Redondo Beach, Palos Verdes (northwest side), Point Vicente, White's Point, Emma-Eva Oil Platforms, Horseshoe Kelp, Huntington Beach, Fourteen Mile Bank, Laguna Beach, Dana Point, and Twin Harbor (Catalina); private boat sites were located near Venice Beach and the Los Angeles-Long Beach breakwater; piers sampled were Malibu, Santa Monica-Venice, Redondo, Cabrillo, Pier J, Belmont, and Newport.

Study Methods and Results

Generally, 20 fish of each species were collected from each site. Composite samples for chemical analysis were prepared by combining a piece of edible tissue from 4 individual fish and, therefore, 5 analyses were conducted for each group of 20 fish. In all cases, the tissue samples taken from these fish represented edible muscle tissue. Tissue concentrations of total DDT and its metabolites (DDE and DDD), chlordanes, and PCBs were determined in all sampled tissues. In addition, 100 composite samples were analyzed for mercury levels, and a single sampling of white croaker from Marina del Rey (20 fish; 5 composite analyses) was analyzed for levels of tributyltin. A comprehensive quality assurance/quality control (QA/QC) program was also conducted as part of this study.

Total DDT (sum of DDT, DDE and DDD concentrations) detected in individual composite samples of the fish tissues (not the average levels) ranged from non-detectable to as high as 8,052 parts per billion (ppb) wet weight at Cabrillo Pier in white croaker. Chlordane levels (sum of cis- and trans-chlordane and trans-nonachlor) were usually non-detectable to as high as 65 ppb (wet wt.) for a composite sample of small surfperches from Pier J. PCBs (sum of aroclors 1,254 and 1,260) were frequently non-detectable, and the highest level was 3,539 ppb (wet wt.) in a sample of white croaker from Malibu. Mercury levels ranged from below 50 ppb to 724 ppb (wet wt.) in rockfishes from White's Point. Tributyltin levels ranged from 52 to 105 ppb (wet wt.) in the five composites of white croaker collected within the Marina del Rey.

Numerous statistically significant differences in mean (geometric) contaminant levels between sites were found for several fish species. Generally, the most contaminated sites appeared to be those off the Palos Verdes Peninsula and around the Los Angeles-Long Beach Harbors.

In general, the white croaker, which is a bottom-feeding species, was the most contaminated fish species at a site, especially if the site was highly contaminated. Other relatively contaminated species were corbina, queenfish, surfperches, and sculpin. Bonito, mackerel, halibut, sand dab, barracuda, opaleye, and halfmoon usually had the lowest levels of contaminants, although in some cases only a few sites were sampled for these species (e.g., for opaleye, halfmoon, barracuda, and sand dab).

Health Risks

For the three carcinogenic contaminants in the study, DDTs, PCBs, and chlordane, the potential theoretical excess cancer risks from consumption of the fish species were estimated for all samples in which contaminant concentrations were above the method detection limits (MDL) of the study (38 ppb for DDTs, 50 ppb for PCBs, and 3 ppb for chlordane). Theoretical risks were estimated for a lifetime using an exposure equal to consuming one meal per week of the species from the site (23 grams/day; equivalent to a 5 3/4 ounce meal per week). These risks ranged from 4.4 excess cases of cancer in a population of one million (4.4×10^{-6}) to 3 in 1,000 (3.0×10^{-3}).

(It should be noted that the theoretical excess cancer risk for PCBs at the MDL [50 ppb] is 1×10^{-4} and, therefore, all positive detections of PCBs result in an estimated risk above 1×10^{-4} .)

Chlordane levels were low in most samples and only occasionally exceeded the MDL. Overall, chlordane did not contribute significantly to a cancer risk in any of the species and locations sampled. Neither methylmercury nor tributyltin were found to occur at levels of significant health concern. It is recommended that the State Mussel Watch program continue to collect data on tributyltin levels, however, to make sure that they are continuing to decline.

Development of Consumption Guidelines

In order to provide useful guidance to anglers and consumers based on findings from this complex study, consumption recommendations were developed using "trigger" levels in the fish species. Recommendations are provided for species and sites which exceeded 100 ppb of either total DDTs or PCBs or 23 ppb of total chlordane. The trigger levels for total DDTs and chlordanes are based on excess cancer risks of about 1 in 100,000 (1×10^{-5}). The above-mentioned problem with the MDL for PCBs, however, prevented setting a conservative health-based level for PCBs, since the risk at the MDL is 1×10^{-4} . The trigger levels were developed specific to this study, therefore, and should not be used in deriving standards.

Consumption recommendations are provided by fish species and by specific geographic site. In addition, general consumption recommendations are provided.

The QA/QC program established that the analyses were adequate, but also noted a negative bias in the data from the contract laboratory. Overall, data from the QA/QC laboratory (Hazardous Materials Laboratory, California Department of Health Services) were about three times higher than the levels reported by the contract laboratory (Pacific Analytical, Incorporated). The sources of this bias were not resolved, but the differences are considered and accounted for in the interpretation of the data and the development of the final recommendations.

Uncertainties in the risk assessment involve the usual orders of magnitude in uncertainties associated with the hazard identification and dose-response methodologies in risk assessment. The standard approach in deriving a carcinogenic potency factor (CPF) involves extrapolating data from laboratory animals to humans, and the resulting CPF is derived so that it does not likely underestimate risk. Therefore, use of the CPF may overestimate actual risks, and real risks are likely to be lower.

Uncertainties involved in the exposure assessment include the use of consumption estimates and the chemical concentrations in the fish tissues. Accurate consumption data are not available, but 23 grams/day is in the range of reported values for consumption by sport anglers. In addition, the negative bias noted above in the analytical data indicates that actual levels may be higher. On the other hand, consumption of other (less contaminated) species would lower the risks. It was concluded that the uncertainty in the exposure assessment ranged from an underestimate of up to 15 times to an overestimate of 17 times.

Guidance for consumption of fish caught within the study area are summarized below. Recommendations are provided for specific sampling sites and for specific fish species sampled in the study. In addition, general fish consumption guidance is provided.

General Dietary Recommendations

OEHHA strongly encourages consumption of seafood in the diet as a general recommendation. Regular consumption of seafood is beneficial for most individuals and is a recommended part of the diet. Individuals should consume one to two meals per week of seafood. The specific guidance which follows is not intended to undermine the recommendation to consume seafood. The specific advisory is in reference to the species of fish caught locally, and if the recommendations are followed, the benefits of consuming the seafood will most probably far exceed the potential risks caused by exposure to chemical contaminants.

OEHHA also provides the following general consumption guidelines to anglers which, in general, will result in decreased overall health risks resulting from consumption of chemically contaminated seafood. OEHHA recommends that, in addition to the specific guidelines, these general guidelines be followed:

1. Eat a variety of different fish species. In this way, exposure to chemical contaminants is reduced in comparison to consumption of only a highly contaminated species.
2. Consume fish caught from several different fishing locations. In this way, overall exposure to chemical contaminants is reduced in comparison to exposure to highly contaminated fish species from highly contaminated sites. In addition, avoid exclusively fishing in the more highly contaminated areas including White's Point, the Los Angeles-Long Beach Harbors, and Horseshoe Kelp.
3. Trim fat from fish fillets and cook fish by baking or broiling on a rack to reduce DDTs and PCBs in the edible portion (DDTs and PCBs tend to concentrate in the fatty tissues of fish). This method of preparation will not reduce concentrations of all chemical contaminants (e.g., metals).

Site-Specific Recommendations

The following recommendations provide guidance for specific fishing locations and species. Anglers may use these recommendations as an indication of how often to fish in an area and/or how often to eat a specific fish species caught at a site. These recommendations should be used with the general recommendations given above. Details on each site and the criteria for establishing the site-specific recommendations are presented in the body of the report.

SITE-SPECIFIC CONSUMPTION RECOMMENDATIONS

<u>SITE</u>	<u>FISH SPECIES</u>	<u>RECOMMENDATION*</u>
Marina del Rey Huntington Beach Fourteen Mile Bank Laguna Beach Redondo Beach Emma/Eva oil platforms Catalina (Twin Harbor) Santa Monica Pier Venice Pier Venice Beach Dana Point	All species	No restrictions
Newport Pier Redondo Pier Belmont Pier Pier J	Corbina " Surfperches "	One meal every two weeks
Malibu Pier	Queenfish	One meal a month
Short Bank	White croaker	One meal every two weeks
Malibu Point Dume	White croaker "	Do not consume
Point Vicente Palos Verdes - Northwest	White croaker "	Do not consume
White's Point	White croaker	Do not consume
	Sculpin Rockfishes Kelp bass	One meal every two weeks +
Los Angeles/Long Beach Harbors (esp. Cabrillo Pier)	White croaker Queenfish Black croaker Surfperches	Do not consume One meal every two weeks +
Los Angeles/Long Beach Breakwater (ocean side)	White croaker Queenfish Surfperches Black croaker	One meal a month +
Horseshoe Kelp	Sculpin White croaker	One meal a month +

* One meal is about six ounces.

+ Consumption recommendation is for all the listed species combined.

Species-Specific Recommendations

For the purpose of providing fish consumption guidance based only on a comparison of fish species in the entire study area, the following groups were formed:

SPECIES-SPECIFIC CONSUMPTION RECOMMENDATIONS

<u>FISH SPECIES</u>	<u>CONTAMINATION GROUP</u>	<u>RECOMMENDATION*</u>
White croaker	HIGH	Avoid consumption
Corbina Queenfish Surfperches Sculpin	MODERATE	Consume not more than one meal every two weeks
Black croaker Barred sand bass Rock fishes Kelp bass	LOW	Consumption not restricted
Bonito Mackerel Sand dab Barracuda Opaleye Halfmoon Halibut	LOWEST	Consumption not restricted

* One meal is about six ounces.

MAP OF SITES SAMPLED IN THE COMPREHENSIVE STUDY OF SOUTHERN CALIFORNIA

